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Could 3D Bioprinted tissues offer future hope for Microtia treatment?

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To the Editor:

Microtia is a congenital deformity where the pinna is underdeveloped. Contraindications to rib surgery for microtia reconstruction include high-risk surgical status and chest-wall deformities [1-2]. However does stem-cell-based 3D Bioprinting offer revolutionary therapeutic options for patients with such tissue abnormalities. As a technology, 3D-bioprinting is being developed to generate homogeneous tissues by depositing a low viscosity printable cellular-active gel which matures into a tissue [3]. Currently on-going research is developing the process towards producing cartilage tissues for use in reconstructive surgery. This process focuses on using the natural self-organising properties of cells in order to produce a functional tissue which has measurable: mechanical, metabolic and functional properties. By harnessing methods as shown in (Figure 1) this could provide a means towards effectively produce the simplified cartilage structures.

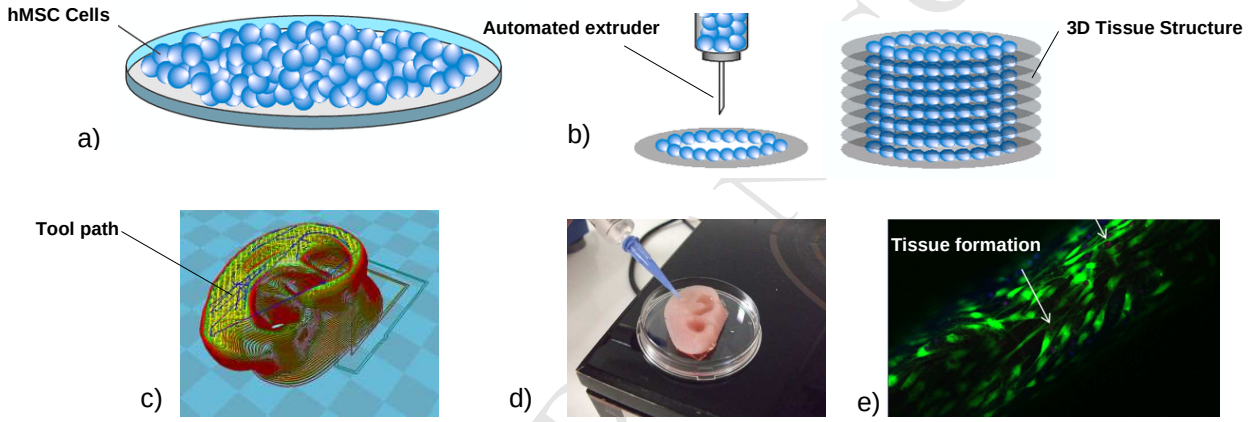

Figure 1. 3D-Bioprinting process in which a biologically active (bioink) is deposited into the shape of an ear structure. (A) *human* mesenchymal stem cells (hMSC) are collected from a patient, put into a growth medium and cultured into many millions of cells. (B) After a period of time in culture, these cells are added to a low viscosity hydrogel suspension consisting of gelatin and alginate. (C) Software control is used to position a high precision extruder in 3D. *(D)* This deposits the bioink in layers to form a cross linkable structure. *(E)* hMSCs post bioprinting show appropriate properties for initiating cartilage formation.

Following the 3D Bioprinting process, these biofabricated structures are transferred to an incubator, which allows maturation to take place. This final process is critical towards the formation of structural and biochemical extra-cellular matrix during tissue maturation.

Early demonstrator research shows the promising potential of such advanced bio-manufacturing processes. It is hoped that in the long-term research will develop 3D bioprinting as a process that can be used to produce multiple tissue types used in operative scenarios. This next stage in the development of this process could one day transform the field of reconstructive medicine. Subsequently, this may lead to direct bio-engineering replacement human tissues on-demand for transplantation.

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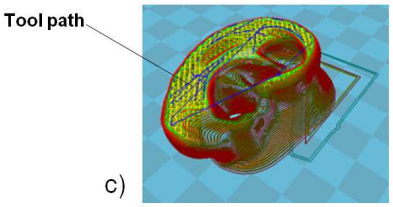

c)

d)

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